# 24. Clonal selection

Some agricultural crops and a large number of horticultural crops are asexually propagated. Some common asexually propagated crops are sugarcane (*S. officinarum*), potato (*S.tuberosum*), sweet potato (*I. batatas*), Colocasia (Taro), Arum, Dioscorea (yams), Mentha, ginger (*Zingiber sp*.), turmeric (*C. domestica*), banana (*Musa paradisiaca*), etc., almost all the fruit trees, *e.g.*, mango *(Mangifera indica)*, citrus *(Citrus* spp.), apples *(P. malus),* pears *(P.commun is),* peaches *(P. persica),* litchi *(Litchi chinensis),* loquat *(Eriobotrya japonica),* etc:, and many ornamentals and grasses. Many of these crops show reduced flowering and seed set, 'e.g., sugarcane, potato, sweet potato, banana, etc., and some varieties of these crops do not flower at all. But many of these crops flower regularly and show satisfactory seed set. However they are propagated asexually to avoid the ill effects of segregation and recombination, both being the inevitable consequences of sexual reproduction.

Segregation and recombination produce new gene combinations due to which the progeny differ from their parents in genotype and phenotype. Asexual reproduction, on the other hand, produces progeny exactly identical to their parents in genotype because the progeny are derived from vegetative cells through mitosis. The advantage of asexual reproduction is immediately clear. It preserves the genotype of an individual indefinitely. It must be noted that this does not depend on the homozygosity of the genotype of an individual. Any genotype is preserved and. maintained through asexual reproduction. In contrast self-pollination preserves and maintains only homozygous genotypes giving rise to purelines.

**Characteristics of Asexually Propagated Crops**

- A great majority of them are, perennial, e.g., sugarcane, fruit trees, etc. The annual crops are mostly tuber crops, e.g., potato, cassava (*M. utilissima*), sweet potato, etc.
- Many of them show reduced flowering-and seed set. Many varieties do not flower at all. Only the crops grown for fruit, particularly where good fruit set depends upon seed formation, show regular flowering and satisfactory seed set.
- They are invariably cross-pollinated.
- These crops are highly heterozygous and show severe inbreeding depression.
- A vast majority of asexually propagated crops are either polyploids, eg., sugarcane, potato, sweet potato, etc., or have polyploid species or varieties.

- Many species are interspecific hybrid, eg., Banana (*M. paradisiaca*), sugarcane, Rubus, etc.
- These crops consist of a large number of clones, that is, progeny derived from a single plant through asexual reproduction. Thus each variety of an asexually propagated crop is a clone.

**Clone**

A clone is group of plants produced from a single through asexual reproduction. Thus asexually propagated crops consist of large number of clones, and they are often known as clonal crops. All the members of a clone have the same genotype as the parent plant. As a result, they are identical with each other in genotype. Consequently, the phenotypic differences within a clone do not have a genetic basis and are purely due to the environmental effects. A selection within a clone is thus useless. The various characteristic of a.clone are summarised below.

**Identical Genotype**

All the individuals belongings to a single clone are identical in genotype. This is so because a clone is obtained through asexual reproduction, which involves mitotic cell division only. Genetic variation in the progeny of a plant is produced chiefly by segregation and recombination, which occur during meiosis only. Thus the genotype of a clone is maintained indefinitely without any change.

**Lack of genetic variation**

The.phenotypic variation present within a clone is due to the environment only.This is so because all the individuals belonging to a single clone have the same genotype.

The phenotype of a clone is due to the effects of genotype (G), the environment (E) and the genotype X 'environment interaction (G x E) the population mean. (μ). Thus the phenotype (P) of a clone may be expressed as follows.

$$P = \mu + G + E + GE$$

Thus the phenotypic differences among clones would be partly due to E and GE components. Hence the efficiency of selection among clones, as among_purelines, would depend upon the precision with which the E and GE components of phenotype are estimated.

**Immortality**

Theoretically, clones are immortal i.e., a clone can be maintained indefinitely through asexual reproduction. But clones usually degenerate due to viral or bacterial infection. A clone

may become extinct due to its susceptibility to diseases or insect pests. Further, genetic variation may arise within a clone changing its characteristics.

**Severe Inbreeding Depression**

Generally, clones are highly heterozygous and show severe loss in vigor due to inbreeding.

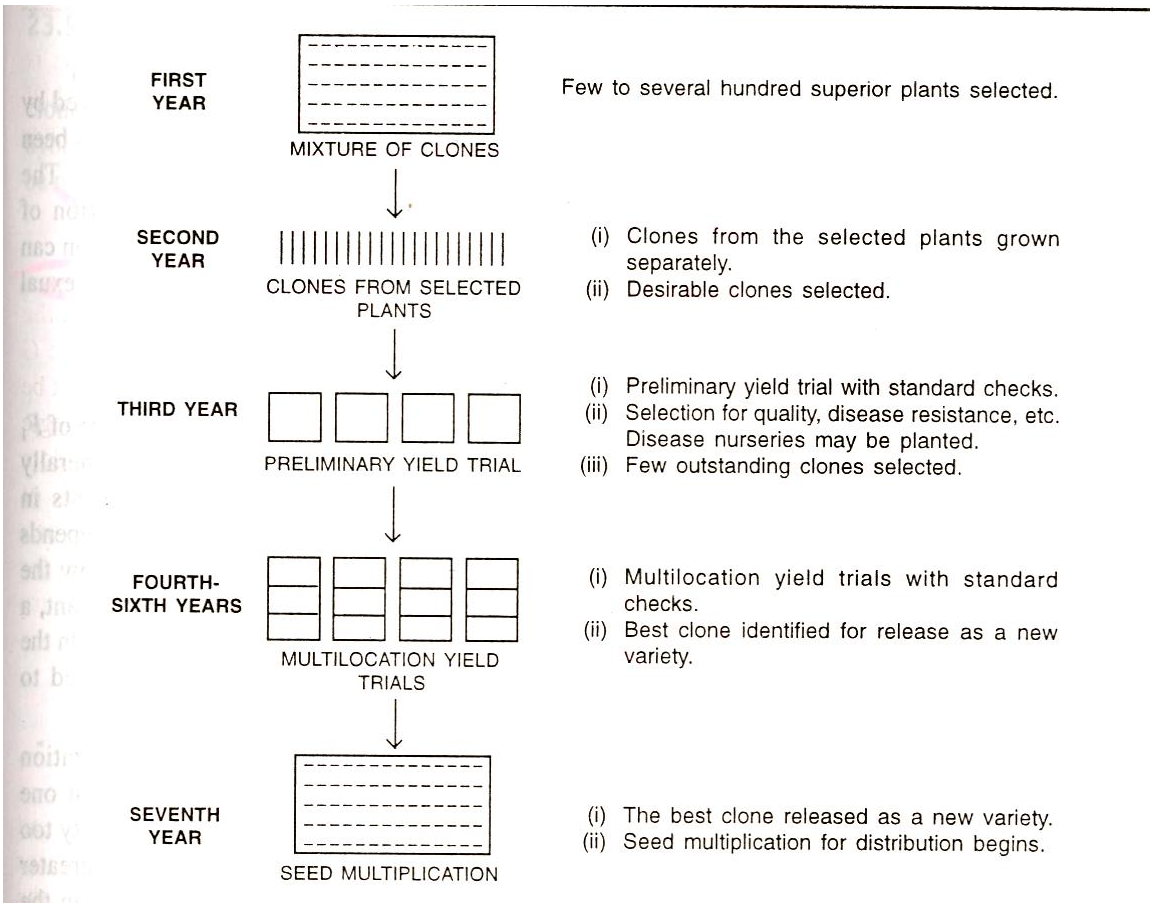
**Clonal Selection**

The phenotypic value of a plant or clone is due to the effects of its genotype (G), the environment (E) and genotype x environment (G x E) interaction. Of these, only the G effects are heritable. The environmental and interaction effects are non heritable and cannot be selected for. Therefore, a selection for quantitative characters based on observations on single plants is highly unreliable. In fact, plants selected in this way may be no better than a random sample.

Further, a selection for characters like yielding ability, etc. on the basis of unreplicated clonal plots would often be misleading and unreliable. Therefore, the value of a clone can be reliably estimated only through replicated yield trials. However, selection for highly heritable characteristics, such as plant height, days to flowering, color, disease resistance, etc., are easy and effective even on the basis of individual plants or single plots. Clearly, these situations are the same as those in the case of sexually reproducing crops.

**Selection Procedure**

In view of these considerations, in the earlier stages of clonal selection, when selection is based on single plants or single plots, the emphasis is on the elimination of weak and undesirable plants or clones. The breeder cannot reasonably hope to identify superior' genotypes at this stage. In the later stages, when replicated trials are the basis of selection, the emphasis is to identify and select the superior clones. The various steps involved in clonal selection are briefly described below and are depicted in Fig.




**1. First Year**

From a mixed variable population, few hundreds to few thousand desirable plants are selected. A rigid selection can be done for simply inherited characters with high heritability. Plants with obvious weaknesses are eliminated.

**2. Second Year**

Clones from the selected plants are grown separately, generally, without replication This is done in view of the limited supply of the propagating material for each clone, and because of the large number of clones involved. The characteristics of clones will be more clear now than in the previous generation when the observations were based on individual plants. The number of clones is drastically reduced and inferior clones eliminated. The selection is based on visual observations and on the basis of clonal characteristics. Fifty to one hundred clones may be selected on the basis of clonal characteristics.

**3. Third Year**

Replicated preliminary yield trial is conducted. Suitable, checks included for comparison. Few superior performing clones with desirable characteristics selected for

multilocation trials. At this stage, selection for quality is also done. If necessary, separate disease nurseries may be planted to evaluate the disease resistance of selected clones.

**4. Fourth to Sixth Years**

Replicated yield trials are conducted at several locations along with a suitable check. The yielding ability, quality and disease resistance, etc. of the clones are rigidly evaluated. The best clone that is superior to the check in one or more characteristics is identified for release as a new variety.

**5. Seventh Year**

The superior clone is multiplied released as a new variety.

**Merits of Clonal Selection**

- It is the only method of selection applicable to clonal crops. It avoids inbreeding depression, and preserves the gene combinations present in the clones.
- Clonal selection, without any substantial modification, can be combined with hybridization to generate the variability necessary for selection.
- The selection scheme is useful in maintaining the purity of clones.

**Demerits of Clonal Selection**

- This selection method utilizes the natural variability already present in the population; it has not been devised to generate variability.
- Sexual reproduction is a prerequisite for the creation of variability through hybridization

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